1927

OAT-SMUT AND ITS CONTROL.

SURVEY AND EXPERIMENTAL WORK, SEASON 1926-27.

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FARMERS in the South Island have lost this season approximately half a million bushels of oats—or, at 3s. per bushel, £75,000—solely through failure to disinfect their seed for smut. The statistics tabulated below, which were collected during January and February of this year, show that in Canterbury oat-smut has caused much greater losses than last year, while in Otago and Southland the amount of smut has been greatly reduced. These results may be in part due to seasonal variations in the severity of attack of the disease, but are certainly mainly due to the care or want of care respectively of farmers in the treatment of their seed oats. Certain districts in Otago and Southland which last year suffered very heavy losses show this year a mere trace of smut in the crops, due to the general adoption by the growers of proper methods of seed-disinfection.

In the Wairau Valley, Marlborough, an interesting position in regard to this disease was disclosed by the survey. Last year no smut was detected in the oat crops in this valley, and it is not the custom for growers there to disinfect their seed. Two crops of Algerian oats were, however, examined in the neighbouring Awatere Valley and found to contain a good trace of smutted heads. The seed for these crops had been specially imported from Canterbury to bring into the district a new strain, and, as is customary in Marlborough, had been sown without disinfection. This year twenty-four crops of oats scattered all over the district were found to contain oat-smut, and wherever the seed origin could be traced it was found to have been the product of the infected crops examined in the Awatere Valley the year before, or to have been directly imported from Canterbury. It seems probable, therefore, that unless the farmers of Marlborough disinfect their seed oats, as they do at present their wheat and barley, they will in the future suffer heavy losses through smut, and seriously impair the clean reputation of Marlborough chaff.

Details of this season's oat-smut survey are given in Tables 1 and 2, together with last year's figures for comparison. The methods used in collecting and estimating are the same as those used last year and published in the *Journal* for March, 1926, page 166. For computing the amount of the losses a bushel of oats has been taken as worth 3s. in both years.

PREVENTIVE TREATMENT.

There is only one way to prevent the occurrence of smut in oats, and that is to sow seed free from infection. Naturally smut-free seed is rare, but almost complete disinfection may be obtained with any line, however smutty, by steeping the seed in formalin prior to sowing. This method is cheap — costing about a penny per bushel of seed— simple to apply, and, if properly carried out, will not lower the percentage germination or vigour of the stand. Many farmers still use the bluestone pickle, but this method, while it reduces the smut to

Table 1.—Number and Condition of Oat Crops examined.

District.	Examined.		Clean.	
	1925–26.	1926–27.	1925–26.	1926–27.
Marlborough	12	52	10	28
Canterbury	35	256	18	79
Otago	100	129	12	30
Southland	110	115	11	5

District.	Smutted.					
	Trace to 1 per Cent.		1 per Cent to 20 per Cent.		Above 20 per Cent.	
	1925–26.	1926–27.	1925–26.	1926–27.	1925–26.	1926–27.
Marlborough ..	2	19	..	4	..	1
Canterbury ..	12	82	5	85	..	10
Otago	41	65	33	29	14	5
Southland ..	47	68	42	33	10	9

Table 2.—Estimated Losses from Oat-smut.

District.	Crops examined.					
	Area.		Actual Loss.			
	1925–26.	1926–27.	1925–26.	1926–27.	1925–26.	1926–27.
	Acres.	Acres.	Acres.	Acres.	Bushels.	Bushels.
Marlborough ..	398	1,219	..	7	..	198
Canterbury ..	1,175	5,901	13·8	201	534	8,844
Otago	5,119	2,609	528	50	20,434	2,176
Southland ..	2,362	2,711	157	112	6,076	5,152
Totals ..	9,054	12,440	698·8	370	27,044	16,370

District.	Statistical Estimate.					
	District Area in Oats.		Loss.			
			Quantity.		Value.	
	1925–26.	1926–27.	1925–26.	1926–27.	1925–26.	1926–27.
	Acres.	Acres.	Bushels.	Bushels.	£	£
Marlborough ..	15,000	15,000	..	2,600	..	390
Canterbury ..	187,000	202,000	84,915	302,465	12,737	45,370
Otago	82,000	78,000	326,938	64,500	49,040	9,675
Southland ..	71,000	66,500	182,277	126,380	27,341	18,957
Totals ..	355,000	361,500	594,130	495,945	89,118	74,392

small proportions, most certainly lowers the germinative energy of the seed. An examination of the detailed results of this season's experiments with both methods, which are given in Table 3, shows this clearly; but still more striking was the difference in vigour seen when the plants were growing side by side.

The method of treatment recommended is as follows: In a tin bath, wooden, iron, or concrete trough, or other receptacle, mix the formalin as purchased with water in the proportion of 1 pint of formalin to 30 gallons of water. Do not guess, but measure the quantities accurately, for on their correctness largely depends the success of the treatment. Put half of each sackful of seed oats into another sack, so

FIG. 1. OAT-SMUT.

[*Photo by H. Drake.*

that the sacks for treatment are not more than half full. Immerse the sacks and grain below the surface of the formalin solution for exactly ten minutes, moving the grain about several times while under. At the end of ten minutes remove the sack from the solution. A good method for this is by means of a block and tackle rigged over the trough, by which the sack can be lifted and left for a while suspended over and draining back into the trough. The sack is then thrown on the ground and the grain flattened out to an even layer within the sack. If the operation is performed in the evening the grain will be fit for sowing the next morning. Do not empty the grain into other sacks unless these have been previously disinfected.

Dipping may be continued in the same solution until the level is too low to cover the sacks, when fresh solution should be added made up in the same proportions — 1 pint to 30 gallons of water. A pint bottle of formalin costs 2s. 9d., and it will make enough solution to treat about 35 bushels of oats.

Some farmers obtain satisfactory results by shovelling the grain on the floor while sprinkling the formalin solution over it from a watering-can. If this method is adopted the heap of grain should be covered overnight with sacks soaked in the formalin solution, and the shovelling should be done very thoroughly so as to make sure that every grain is completely wetted by the solution. The steeping method as described is in general safer, both in regard to smut-control and in avoiding damage to the seed, and is at least as easy to carry out, provided a suitable dipping-trough is available.

FIG. 2. PORTION OF CEREAL SMUTS TRIAL PLOTS AT ASHBURTON EXPERIMENTAL FARM, SEASON 1926–27.

[*Photo by J. W. Hadfield.*

It will be noticed that the strength of formalin solution recommended has been increased from 1 pint in 40 gallons to 1 pint in 30 gallons. This year's experiments (Table 3) show that the increased strength is quite safe, and is more effective in controlling the smut.

SUMMARY OF EXPERIMENTAL RESULTS.

The experiments on the control of oat-smut were this year confined to the hot-water, bluestone, and formalin methods, last year's work having shown these to be the most effective. Six varieties of oats were used, five of which showed heavy smut-infection in the untreated controls, the sixth (Algerians) remaining clean throughout. A series of samples dipped for ten minutes in water held at temperatures from 121° F. to 141° F. showed that the germinative vigour of the seed was

Table 3.—Oat-smut Experiments at Ashburton Experimental Farm, Season 1926–27.

Sown, 16th–19th October, 1926; first count, 17th November, 1926; final count, 1st–5th February, 1927.

Treatment.	Garton.									Dun.									Algerian.								
	Percentage Germination.			Plants.			Heads.			Percentage Germination.			Plants.			Heads.			Percentage Germination.			Plants.			Heads.		
	In Field.									In Field.									In Field.								
	First Count.		Mature Plants.	Total.	Smutted.	Percentage smutted.	Total.	Smutted.	Percentage smutted.	First Count.		Mature Plants.	Total	Smutted.	Percentage smutted.	Total.	Smutted.	Percentage smutted.	First Count.		Mature Plants.	Total.	Smutted.	Percentage smutted.	Total.	Smutted.	Percentage smutted.
	%	Pe.								%	Pe.								%	Pe.							
Control	69·2	1·72	63·7	255	116	45·5	876	354	40·4	79·0	1·23	78·2	313	99	31·6	1621	441	27·2	93·0	0·98	85·7	343	0	0	1367	0	0
10/121	73·5	1·57	70·0	280	9	3·2	1018	29	2·8	87·7	0·94	86·5	346	13	3·7	1734	66	3·7	92·2	1·06	88·7	355	0	0	1557	0	0
10/123	75·2	1·76	72·7	291	1	0·3	1026	3	0·3	86·2	1·72	82·0	328	0	0	1661	0	0	92·5	0·95	87·2	349	0	0	1514	0	0
10/125	76·5	1·16	71·0	284	0	0	884	0	0	84·7	1·09	78·0	312	4	1·2	1640	20	1·2	90·7	0·97	87·0	348	0	0	1361	0	0
10/127	74·7	1·45	68·0	272	0	0	893	0	0	86·5	1·10	82·7	331	1	0·3	1771	8	0·4	91·2	1·32	85·2	341	0	0	1414	0	0
10/129	78·0	1·08	73·2	293	0	0	982	0	0	87·7	0·97	82·5	330	1	0·3	1750	5	0·3	88·2	1·06	89·5	358	0	0	1653	0	0
10/131	76·2	1·59	74·7	299	0	0	1145	0	0	91·2	0·72	86·5	346	0	0	1742	0	0	87·7	1·06	85·2	341	0	0	1593	0	0
10/133	74·2	1·72	70·5	282	0	0	1117	0	0	88·0	1·18	88·0	352	0	0	1945	0	0	86·7	1·06	83·0	332	0	0	1520	0	0
10/135	79·2	1·32	74·7	299	0	0	1162	0	0	91·5	1·16	89·5	358	0	0	1977	0	0	84·2	1·03	81·2	325	0	0	1592	0	0
10/137	76·7	1·19	73·0	292	0	0	1138	0	0	92·7	1·19	90·2	361	0	0	2238	0	0	82·5	1·21	81·5	326	0	0	1658	0	0
10/139	70·5	1·30	68·0	272	0	0	1075	0	0	87·0	1·13	86·0	344	0	0	2058	0	0	76·5	1·60	76·2	305	0	0	1543	0	0
10/141	58·0	1·57	55·0	220	0	0	1011	0	0	78·2	1·56	76·7	307	0	0	1988	0	0	71·5	1·46	74·2	297	0	0	1517	0	0
Control	74·0	1·97	71·5	286	140	48·9	1099	486	44·2	82·7	1·26	81·2	325	106	32·6	1917	525	27·3	88·0	0·93	82·5	330	0	0	1510	0	0
Bluestone 2% ..	58·5	1·78	60·0	240	3	1·2	804	4	0·5	54·7	1·40	73·7	295	8	2·7	1444	18	1·2	64·5	1·33	76·2	305	0	0	1160	0	0
Formalin 1–240 ..	82·7	0·68	76·0	304	1	0·3	1053	1	0·1	93·7	0·91	90·5	362	0	0	2003	0	0	93·5	0·78	85·7	343	0	0	1504	0	0
Formalin 1–320 ..	78·0	1·08	73·2	293	1	0·3	983	1	0·1	94·5	0·74	89·7	359	0	0	1931	0	0	93·5	0·95	87·5	350	0	0	1502	0	0
Formalin 1–480 ..	80·5	1·37	74·7	299	35	11·7	993	95	9·5	95·0	0·65	92·7	371	7	1·8	1983	25	1·2	91·0	1·10	88·0	352	0	0	1538	0	0
Control	70·7	1·06	65·2	261	123	47·1	931	389	41·7	86·0	0·93	84·5	338	89	26·3	1960	428	21·8	95·2	0·68	87·5	350	0	0	1531	0	0

Table 3.—Oat-smut Experiments at Ashburton Experimental Farm, Season 1926–27—continued.

Treatment.	Sparrowbill.									Black Supreme.									Providence.								
	Percentage Germination.			Plants.			Heads.			Percentage Germination.			Plants.			Heads.			Percentage Germination.			Plants.			Heads.		
	In Field.									In Field.									In Field.								
	First Count.		Mature Plants.	Total.	Smutted.	Percentage smutted.	Total.	Smutted.	Percentage smutted.	First Count.		Mature Plants.	Total.	Smutted.	Percentage smutted.	Total.	Smutted.	Percentage smutted.	First Count.		Mature Plants.	Total.	Smutted.	Percentage smutted.	Total	Smutted.	Percentage smutted.
	%	Pe.								%	Pe.								%	Pe.							
Control	80·0	1·37	73·0	292	60	20·5	1052	162	15·4	88·5	0·85	84·7	339	80	23·6	882	156	17·7	78·7	1·72	71·2	285	66	23·1	806	151	18·7
10/121	84·7	1·34	76·5	306	3	1·0	989	8	0·8	90·7	0·97	87·5	350	7	2·0	856	16	1·9	90·5	0·98	85·0	340	4	1·2	813	9	1·1
10/123	88·7	1·26	80·2	321	0	0	972	0	0	90·0	0·70	85·7	343	2	0·6	815	4	0·5	89·2	0·94	85·5	342	5	1·4	749	11	1·4
10/125	90·2	0·80	80·5	322	1	0·3	950	4	0·4	90·2	1·00	84·0	336	1	0·3	873	2	0·2	91·2	1·12	84·0	336	2	0·6	782	4	0·5
10/127	88·7	1·09	81·5	326	0	0	976	0	0	90·2	0·87	82·0	328	0	0	908	0	0	86·7	0·80	80·0	320	0	0	803	0	0
10/129	89·2	1·17	83·5	334	0	0	1050	0	0	91·0	0·85	84·7	339	0	0	915	0	0	86·2	0·76	77·7	311	0	0	843	0	0
10/131	88·5	0·85	80·5	322	0	0	1012	0	0	87·0	0·70	80·2	321	0	0	840	0	0	84·0	0·89	77·7	311	0	0	853	0	0
10/133	89·5	0·93	83·0	332	0	0	959	0	0	87·2	1·03	81·2	325	0	0	869	0	0	85·2	1·56	77·2	309	0	0	814	0	0
10/135	87·5	1·30	78·5	314	0	0	891	0	0	86·0	1·21	80·5	322	0	0	879	0	0	84·7	0·87	76·5	306	0	0	801	0	0
10/137	82·5	1·16	76·7	307	0	0	944	0	0	86·0	1·57	85·0	340	0	0	965	0	0	87·0	1·37	80·7	323	0	0	811	0	0
10/139	59·5	1·46	57·0	228	0	0	767	0	0	81·7	1·56	78·5	314	0	0	879	0	0	84·0	0·89	80·5	322	0	0	882	0	0
10/141	40·0	1·54	38·5	155	0	0	629	0	0	78·0	1·44	75·2	301	0	0	855	0	0	74·0	1·65	72·7	291	0	0	818	0	0
Control	83·7	1·06	77·5	310	61	19·6	1004	156	15·5	90·7	1·09	89·2	357	145	40·6	928	277	29·8	79·5	1·75	75·2	301	66	21·9	919	183	19·9
Bluestone 2% ..	65·5	1·69	67·5	270	1	0·4	729	3	0·4	79·7	1·57	80·0	320	14	4·4	779	32	4·1	79·5	1·37	76·2	305	0	0	842	0	0
Formalin 1–240 ..	94·5	0·85	83·0	332	0	0	967	0	0	89·2	1·09	84·5	338	0	0	864	0	0	87·0	1·21	82·3	331	0	0	1047	0	0
Formalin 1–320 ..	93·0	0·78	88·5	354	1	0·3	1024	2	0·2	88·7	1·00	78·0	312	2	0·6	803	4	0·5	88·0	1·13	84·0	336	0	0	929	0	0
Formalin 1–480 ..	88·2	1·22	84·5	338	4	1·2	908	8	0·8	89·5	0·78	84·5	338	25	7·4	801	47	5·8	86·7	1·36	83·2	333	1	0·3	887	3	0·3
Control	87·5	1·02	83·2	333	60	18·0	899	137	15·2	88·5	1·28	79·2	317	131	41·3	789	287	36·3	77·7	1·51	74·7	299	85	28·4	980	239	24·2

not impaired up to 137°, and that only with the Sparrowbill sample was there a serious drop in germination at 141°. With the Garton seed (Abundance), which gave 47 per cent. of smut in the controls, no smut appeared at temperatures above 123°. The Sparrowbill, Black Supreme, and Providence varieties showed no smut above 125°, while the Duns gave one smutted plant at 127° and 129° F., but none above that temperature. A gradual increase in tallness of the plants at harvest was apparent in all varieties, as compared with the control rows, through 121° to 133°, this being maintained to 137°, and dropping off to control level again at 141°.

Bluestone (copper sulphate) showed satisfactory results only with the variety Providence, in which it controlled the smut, with a slight improvement in germination over controls. With the other varieties bluestone failed to control the smut, and it impaired the vigour of the seed, so that not only was the total germination less but it was delayed with many of the seeds for several weeks. In the tabular results it will be seen that bluestone alone showed a higher percentage count of mature plants than at the first count, when the majority of the plants were 3 in. to 4 in. high. In addition the bluestone rows looked sickly and yellow compared with the healthy green of the control and formalin rows alongside.

Three strengths of formalin solution were used: 1–240 (1 pint to 30 gallons), 1–320 (1 pint to 40 gallons), and 1–480 (1 pint to 60 gallons), in each of which the seed was dipped for ten minutes and drained, kept moist and covered overnight, and sown on the following day. No significant difference could be detected between the three treatments in regard to germinative vigour, and all three were in general better than the untreated controls. In regard to smut-control, the 1–240 strength completely controlled the smut, except in the Gartons, where one seed escaped disinfection. The 1–320 strength controlled the smut with Duns and Providence, but failed to do so in the other varieties, though the amount was reduced to less than 1 per cent. The 1–480 strength failed to control the smut in any of the varieties.

INTERNATIONAL CONGRESS OF AGRICULTURE, 1927.

THE thirteenth International Congress of Agriculture will be held at Rome from 23rd to 28th May this year. The programme of the congress is divided into six sections, as follows: (1) International Conference of Agricultural Associations; (2) Agricultural Cultivation and Industry; (3) Zootechnics; (4) Training and Co-operation in the Agricultural Industry; (5) Agricultural Geology and Climatology; (6) Women's Section, dealing with women's organizations in rural districts, domestic economy, and the development of rural life. The main topic for discussion in Section 3 will be the problem of the world production of meat and milk from an economic and social standpoint; and that in Section 2 the cultivation of cereals from a similar point of view.

Winton Experimental Farm Pasturage.—Referring to last month's article on top-dressing trials at Winton Experimental Farm, the weeds shown by botanical analysis to be present in the pasture of Block 3 (ranging from 6 to 8 per cent. of the herbage) were Scotch thistle, catsear, hawkweed, mouse-eared chickweed, and scarlet pimpernel. In the unlimed strips Yorkshire fog and sweet vernal were also present.

"NATURAL CONTROL" OF WEEDS AND INSECTS BY FUNGI.

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"NATURAL CONTROL" is a shibboleth that has been much before the public in recent years, owing to the amount of prominence it has been given in the Press. The possibility of eliminating a weed or insect without direct labour or monetary expenditure has an especial appeal to the farmer or orchardist. The writer has of late received increasing numbers of specimens of weeds, insects, and the like, sent in by farmers and others to the Laboratory for examination, which were supposed to be killed by some "natural enemy."

The possible value of fungi as controllants of weeds and insects has been held in view by the Department of Agriculture for many years; and since the writer commenced his duties as Mycologist in 1919 he has had to carry out much experimental and observational work in this connection. The present article brings together the results of this work.

FUNGI ATTACKING WEEDS.

Canadian Thistle (*Cnicus arvensis*).

A rust, *Puccinia obtegens*, which attacks this plant is perhaps one of the finest examples of the effects of control of any weed by a fungus. This organism has been present in New Zealand to the writer's knowledge for at least forty-six years (for specimens are in his herbarium collected in Canterbury in 1881 by T. Kirk), and is so widespread that it can be found in almost any clump of Canadian thistle. Once a patch becomes infected the disease persists for an indefinite period, and is noticeable for many years. One such clump of diseased thistle the writer noticed first in 1916, on the banks of the Turakina River, Wellington District, and on a visit this season it was found still to be infected. Once the rust becomes established it attacks a proportion of the plants, distorting them and so altering their colour as to render them conspicuous. Such plants fail to set seed (if female), as they usually succumb shortly after flowering. As has been mentioned, the disease is so widespread that scarcely a patch is free from it, whether in Auckland or Southland; yet Canadian thistle is spreading each year. The fact remains that only a proportion of the plants are infected, and although these are prevented from seeding, and usually killed, yet others in the clump reach maturity and produce more than sufficient seed necessary for perpetuation and spread.

The rust may be readily spread artificially; for all one has to do is to select a diseased stem, and, in the late spring during wet weather, thresh healthy plants with it. But even when this is carried out systematically, so that every individual plant in the patch is inoculated, at best not more than about 50 per cent. of the plants show signs of the disease the following season (for it is in the season after inoculation that the disease distorts the plants). This matter has been discussed more fully by A. H. Cockayne (1, 2).